comprised of separate X and Y electrodes, and taught in CIRQUE(™) Corporation U.S. Pat. Nos. 5,305,017, 5,565,658, and 5,861,875, is that the technology does not depend upon having a well established earth ground. Mutual capacitance enables detection of a finger changing the capacitance between the X and Y electrodes. An earth ground is not important in its measurement methodology. Thus, the increase in touchpad sensitivity combined with the advantages of mutual capacitance technology enable the CIRQUE(™) touchpad to accomplish accurate proximity sensing.

[0058] It is important to recognize that the touchpad technology of the present invention also had to be significantly modified to operate in the environment of a mobile telephone.

[0059] One modification is the material being used for the substrate of the touchpad. A typical mutual capacitance-sensitive touchpad is comprised of an X and a Y electrode grid. As taught in the co-pending applications, the electrode grids of the present invention are formed on a flexible and non-conductive material. There are several products on the market which can be used for this purpose. But even plastic or MYLAR(™) can be used.

[0060] More specifically for materials, the present invention requires a flexible substrate, and has used polyethylene terephthalate (PET) to fulfill this role. However, PET is typically not transparent. It is typically a dark amber-like material that may not allow enough light through to illuminate the keys if it is used for the touchpad. Thus, the presently preferred embodiment utilizes a clear or more transparent film for the substrate, such as polyethylene naphalate (PEN). Thus, any film with suitable properties can be used such as a polyester or polyimide film with suitable transparency characteristics.

[0061] Another important property of the touchpad substrate in the presently preferred embodiment is that it be capable of being soldered. It is desirable to solder electrical connectors and/or components directly to the touchpad substrate material. PET has a melting point that is typically below that of solder. However, PEN has a higher temperature coefficient that is slightly above solder, and can be used for the touchpad substrate.

[0062] Another advantageous property of the touchpad substrate is that it should be thin enough to provide the flexibility to conform tightly to the underside of the keymat **22**. Therefore, the touchpad substrate should have desirable transparency characteristics, temperature coefficient, flexibility, and be thin and non-conductive.

[0063] The electrode grids can be formed in various ways that are well known to those skilled in the art and are explained in the previously cited CIRQUE(™) patents. **FIG. 4** is an illustration of the prior art that shows that an X grid **50** be separated from a Y grid **52** by some dielectric insulating material. Thus, the X grid **50** can be disposed on a first substrate **54**, the Y grid **52** can be disposed on a second substrate **56**, and the first substrate is coupled to the second substrate, with the upper substrate **56** forming the intervening dielectric insulating material.

[0064] More specifically in the present invention, **FIG. 5** is provided to illustrate the presently preferred embodiment and layout characteristics of the touchpad **26**. **FIG. 5** is a cross-sectional profile view of the touchpad **26** of the presently preferred embodiment. The base substrate has a first electrode grid layer **62** disposed thereon. This could be the X or the Y grid. The next layer is a dielectric insulating material **64** that is well known to those skilled in the art. Then a second electrode grid **66** is disposed on top of the dielectric insulating material **64**. Another insulating and protective layer **68** is typically disposed on top of the second electrode grid **66** simply to prevent damage. This protective layer **68** is typically the same dielectric insulating material used between the electrode grid layers **62**, **66**.

[0065] The process for disposing the electrode grid layers **62** and **66** on the substrate **60** and the dielectric insulating material **64** is taught in the co-pending applications. However, it can be summarized as the silk screening of a conductive ink, such as indium-tin-oxide (ITO). However, by utilizing PEN or other similar film as the substrate **60**, it is also possible to etch copper on one side of the substrate **60**, and print the conductive ink on the other. Through-holes in the substrate can then be used to connect the electrode grids to copper traces. The ability to etch copper enables connections to be made to electronic components that are also disposed directly onto the substrate **60**, and eliminate the need to provide a means for coupling to off-board electronics.

[0066] An important aspect of the invention can now be illustrated in the following figures. Beginning with **FIG. 6**, this figure shows a top view of one of the electrode grids. For purposes of example only, it will be referred to as the Y electrode grid layer **62**. The Y electrode grid **70** is comprised of various electrode fingers as shown. The electrode grid **70** is surrounded by a grounding ring electrode **72** to reduce noise interference.

[0067] A significant new feature on the Y electrode grid layer **62** that is different from previous touchpads manufactured by CIRQUE(™) Corporation are the apertures **28**. There is an aperture **28** for each of the keys **20** on the keypad **18** of the mobile telephone **10**. Thus, the exact placement and number of apertures **28** may vary, depending upon the style and keypad **18** layout of the mobile telephone being used. This embodiment of twenty-one keys is illustrative only. Furthermore, the number of columns and rows can be adjusted as needed.

[0068] A significant feature of the Y electrode grid **70** is that some of them are not straight. Two of the electrodes **70** are forced to bend around the apertures **28**. Performance of the touchpad **26** with electrodes that have a non-linear portion can be affected significantly. Fortunately, the present invention is able to compensate for the electrodes having a non-linear portion. This is accomplished using an offset.

[0069] The offset is a function of known index locations. For example, a typical CIRQUE(™) touchpad utilizes a 12 electrode by 16 electrode grid. This provides 192 raw index locations from which to determine the position of a finger. Because of the smaller dimensions of the mobile telephone, it is necessary to reduce the total number of electrodes in both the X and Y electrode grid layers **62**, **66**. In the preferred embodiment, the electrode grid is now 6 electrodes by 8 electrodes. In this embodiment, there are 8 Y electrodes **70**, and 6 X electrodes **74**. That means that there are one fourth (6×8=48) the total number of raw index locations to use in determining the location of the finger over the